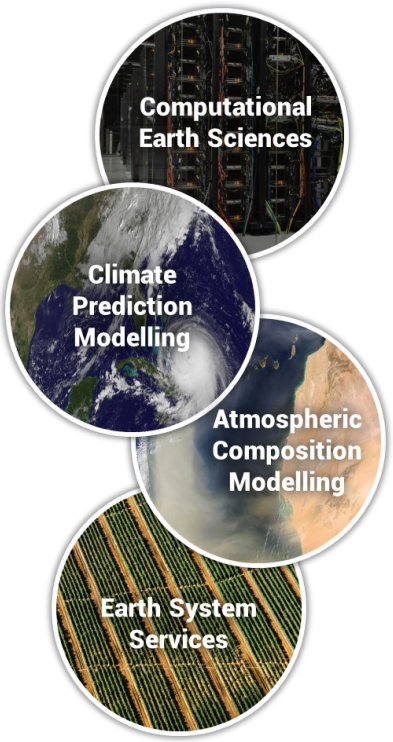
Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

THE DEPARTMENT OF EARTH SCIENCES AT BARCELONA SUPERCOMPUTING CENTER



The Department of Earth Sciences of the Barcelona Supercomputing Center-Centro Nacional de Supercomputación (BSC-ES, bsc.es/earth-sciences) is one of the most active groups in air quality and atmospheric composition modelling, climate prediction and climate services in Europe. The department is currently composed of about 100 people, including scientific, technical and support staff. These are structured in four distinct but interacting research groups: **Earth System Services**, **Atmospheric Composition**, **Climate Prediction** and **Computational Earth Sciences**. The common vision and major scientific interests to all four groups are gathered under a departmental strategic plan, which is updated every second year.

Mission

The BSC-ES mission is performing research on environmental forecasting, with a particular focus on the atmosphere-ocean-biosphere system. This research seeks to support the main societal challenges related to global air quality and climate change through the use of models and data analysis applications in high-performance computing (HPC) and big data infrastructures. Another key task is the dissemination of real-time air quality and climate information based on its research expertise in collaboration with both the Spanish authorities and the World Meteorological Organisation (WMO).

Strategic objectives

1. **Develop an online chemical weather model from global to urban scales** to better understand and predict the chemical composition of the atmosphere (e.g. concentration of CO2, O3, NO2, particles) and its effects on weather, air quality, climate, health and ecosystems.

2. **Implement the most reliable and skillful climate prediction system covering time scales from a month to several decades** into the future at global and regional spatial scales, to further our understanding of the climate system interactions and predictability.

3. **Investigate the impact of weather/climate and atmospheric composition on socio-economic sectors through the development of user-oriented services** that ensure an efficient knowledge and technology transfer for adaptation policies and practices in a rapidly changing environment.

4. Make optimal use of cutting-edge HPC and Artificial Intelligence (AI) methodologies to **increment the efficiency, portability and user-friendliness of Earth system models**, including the pre- and post-processing of weather, atmospheric chemistry and climate model data.

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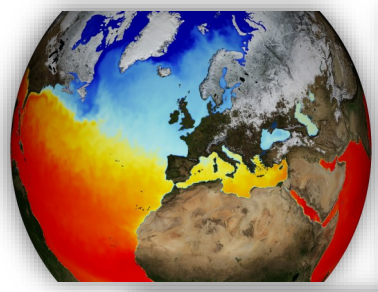
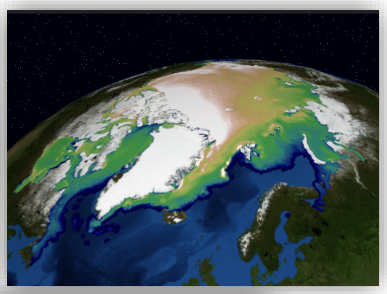
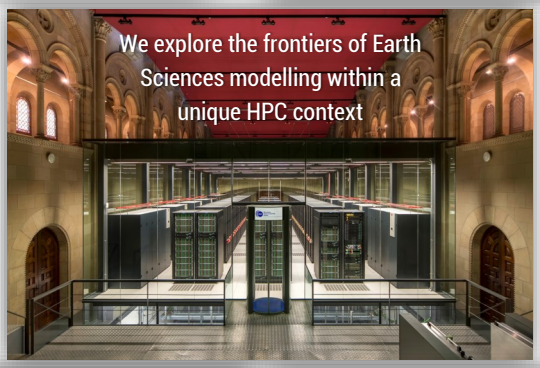
These objectives have been chosen to respond to societal demands identified at the national and international level (e.g. UN Sustainable Development Goals), and also through the interaction with local neighbouring institutions and other research institutes with complementary interests. By striving towards these objectives, we hope to **make the department a reference on the application of the latest HPC and AI technologies to solve weather, climate and air quality problems for the benefit of a range of societal sectors.**

Preparing and optimizing our Earth system models for the next generation of high-performance computing platforms, a key step to enable the use of frontier climate modelling resolutions (1 km in the atmosphere, globally) for prediction purposes.

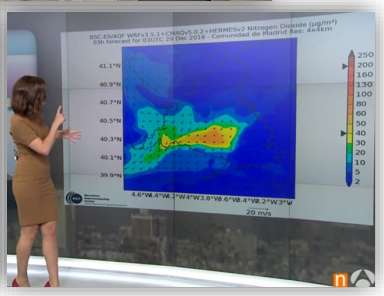




Investigating the present and future changes in the Arctic region, their predictability, their drivers and the climate impacts they exert on the mid latitudes (with particular interest in Europe).



Implementing a Decision Support Tool for the renewable energy sector, co-designed with users, to tailor data from sub-seasonal to seasonal climate predictions to their needs, and thus allow for better informed strategies.



Developing and maintaining the CALIOPE air quality forecast system, the reference operational system in Spain, used to predict air pollution episodes.

Departmental research activities combine state-of-the-art climate forecast systems with the most up-to-date observational datasets (e.g. the latest satellite products from ESA) and sophisticated techniques of analysis (e.g. AI-based), all contributing to produce cutting-edge science. **The BSC-ES is thus playing an increasing role, proportional to its size, in the national and international scenes, as attested by the substantial amount of competitive resources obtained in the last few years**. This role is also benefiting local institutions and supporting the growth of a robust atmospheric composition and climate modelling Spanish network, while it plays a key role in the development of the Copernicus services.

Finally, through a blend of basic-science, applied-science and service-oriented activities, the BSC-ES emerges as a unique environment for interdisciplinary research, which places it in a privileged position to address future societal challenges, and the emerging needs of different public and private sectors.

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